

Organic Aerosol Fractionation Using Subcritical Water

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Subtask 2.2 – Fine Particulate Characterization and Source Apportionment
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What is subcritical water?

- Subcritical water can be defined as hot water under sufficient pressure to maintain the liquid state. (hot water, superheated water)

Why subcritical water?

- The polarity can be controlled with change of temperature.
- As the polarity of water is controlled also solubility is controlled. The solubility of PAHs and pesticides increases by an order of magnitude with every 50 °C.
- Water is not toxic.



Characterization of Organic Aerosols

Limitation of Current Methods

- Organic solvents employed extract non-polar or slightly polar organic compounds (20-50% of carbonaceous extracted).
- GC/MS analyses (not all compounds suitable)

Our Approach

- Sequential fractionation with subcritical water
- Characterization using toxicity tests



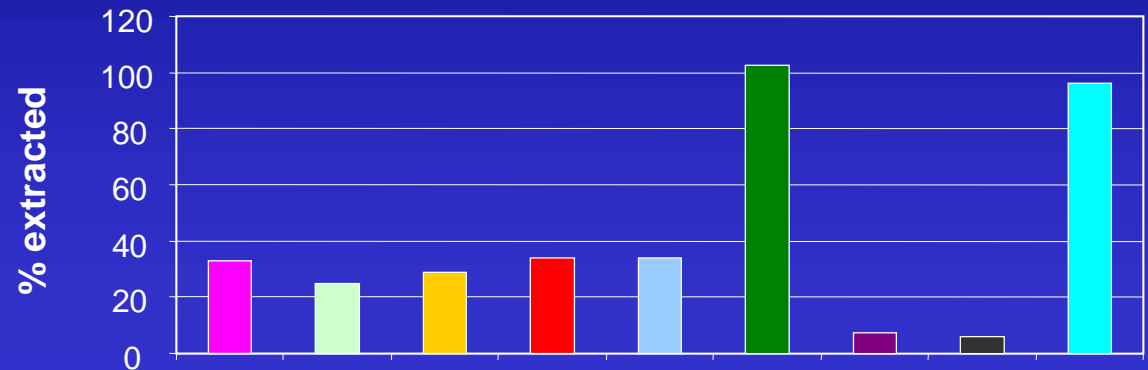
Fractionations With Subcritical Water Were Performed With Two Common Carbonaceous Aerosols:

- **Wood Smoke Particulate (polar matrix)**
- **Diesel Exhaust Particulate (relatively non-polar matrix)**

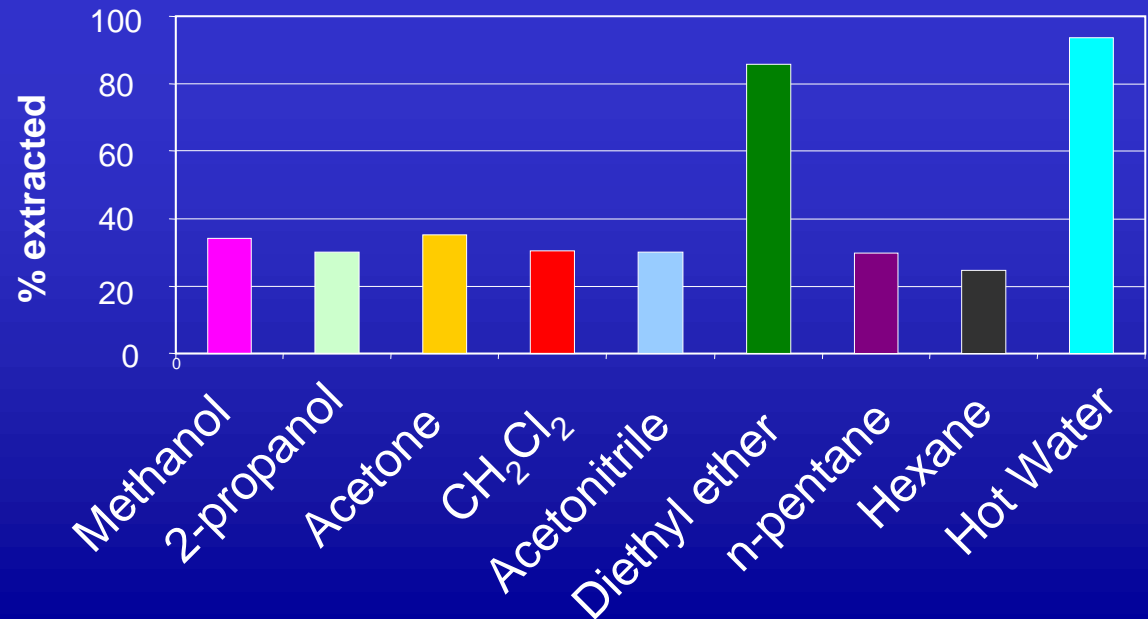


Comparison of Subcritical Water Extraction to Other Organic Solvents

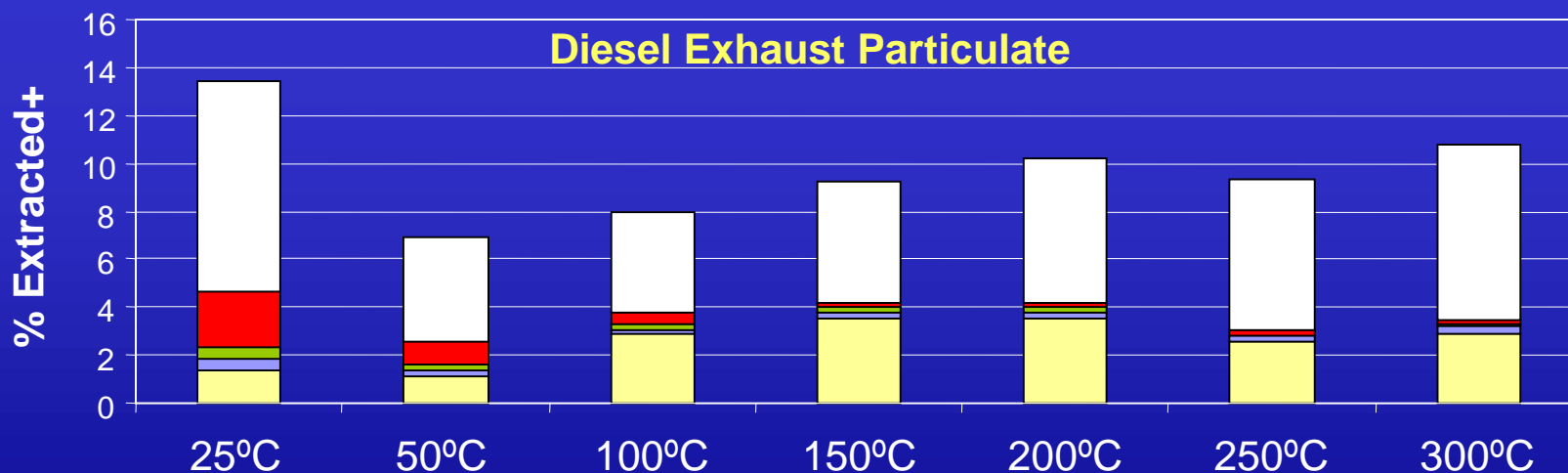
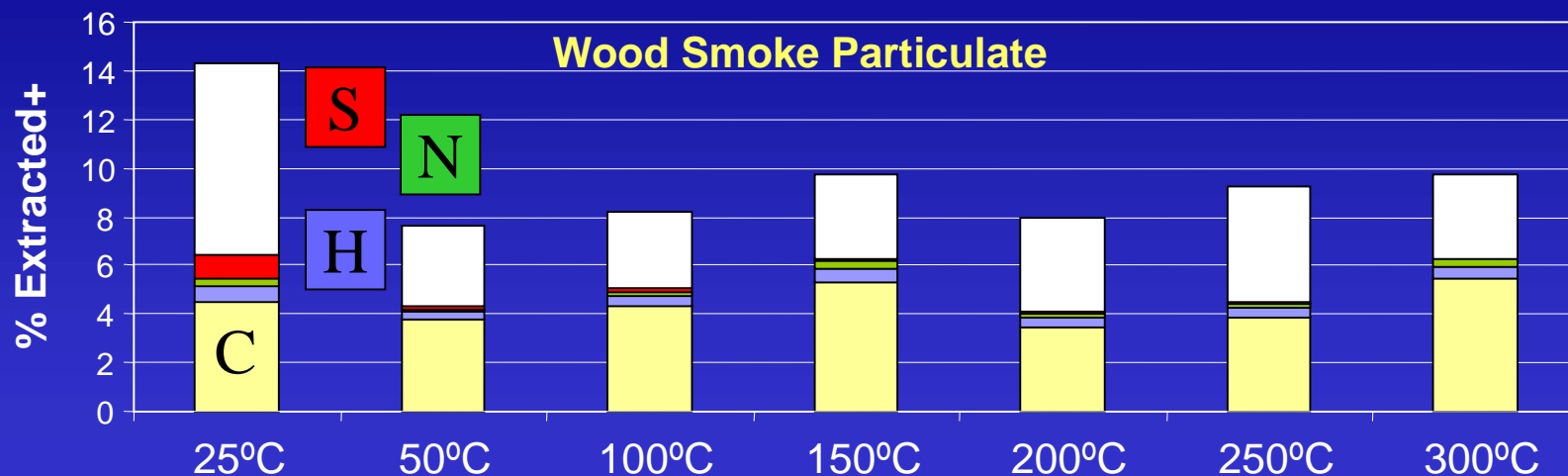
Wood Smoke Particulate



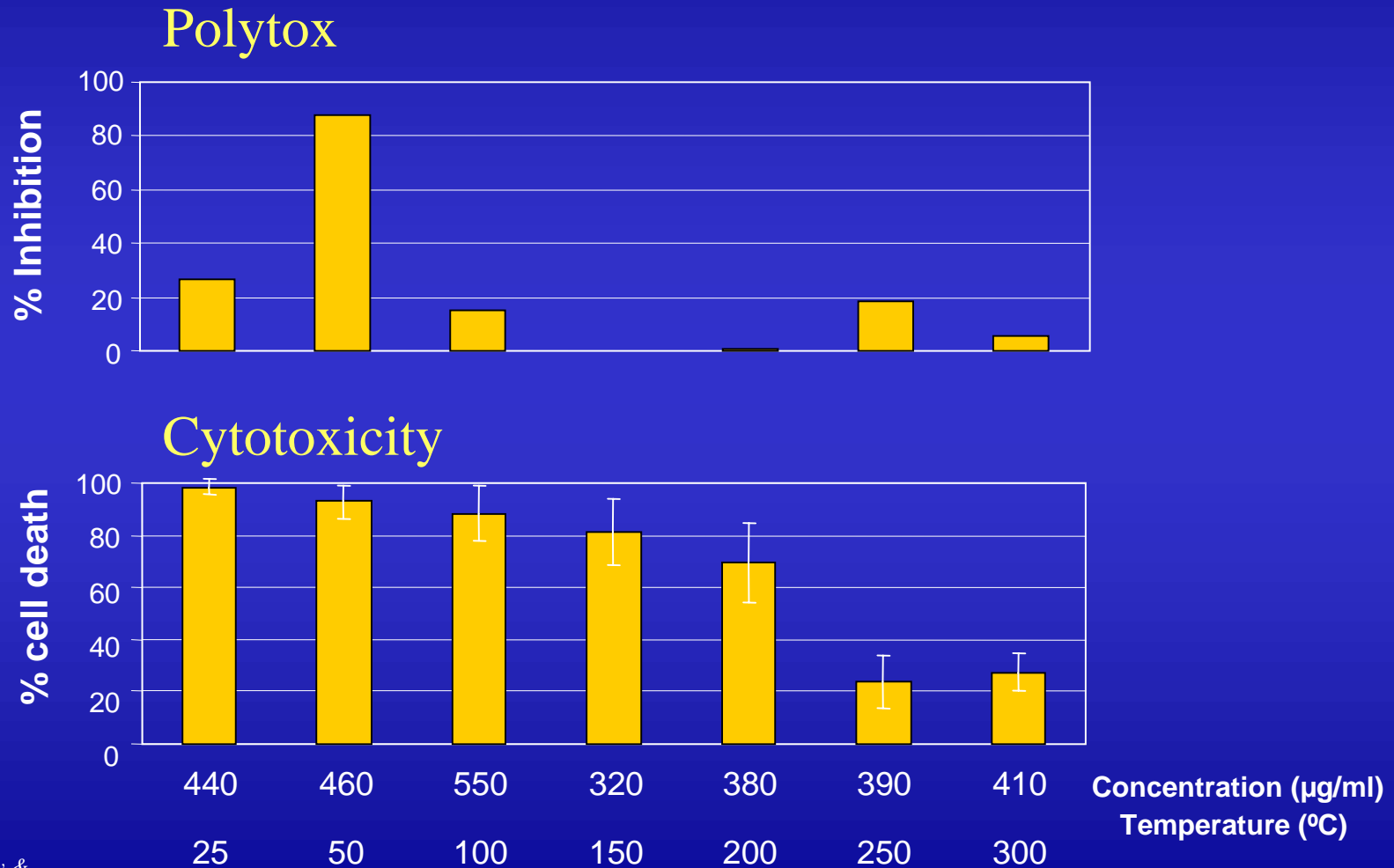
Diesel Exhaust Particulate



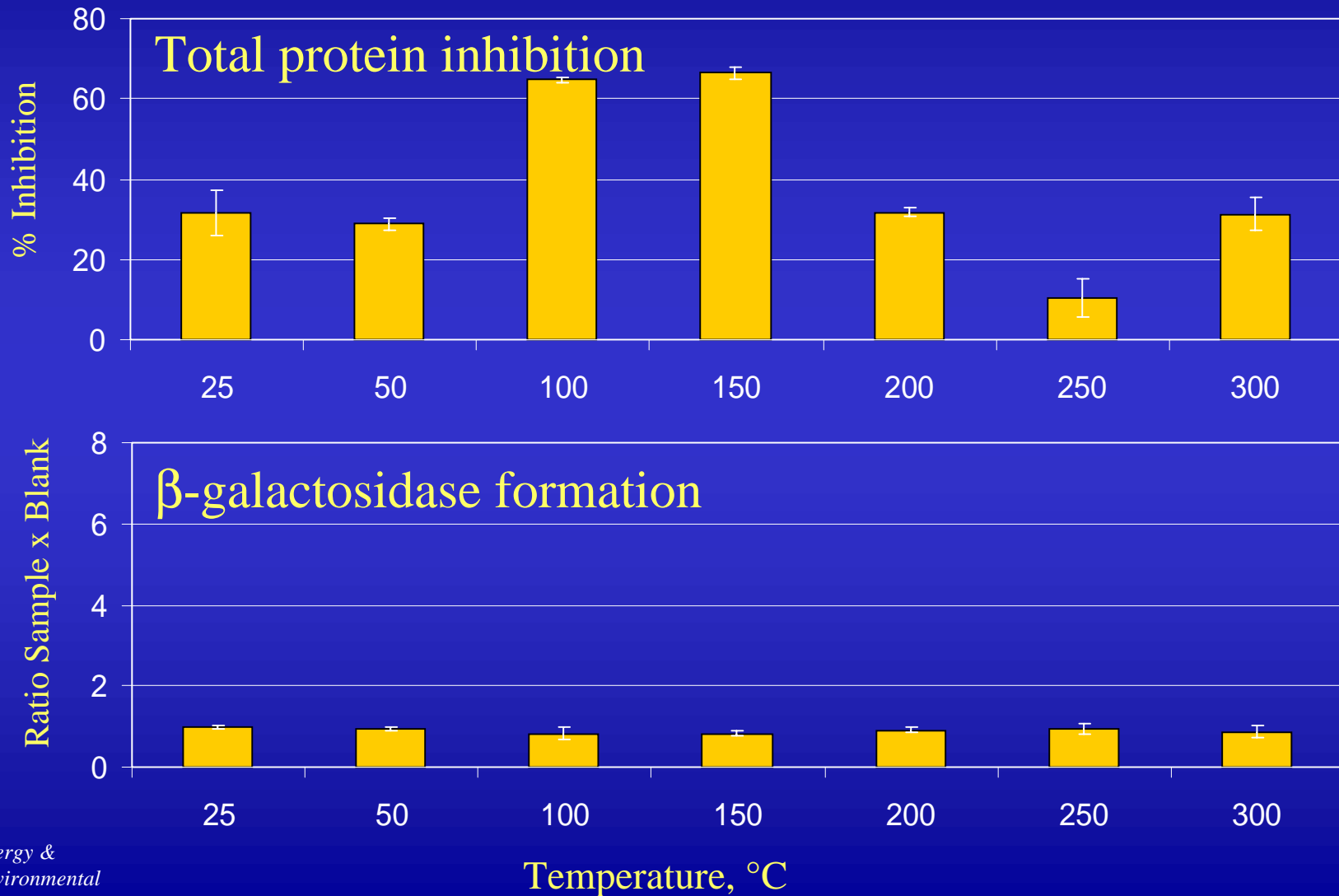
Fractionation of Aerosols with Subcritical Water



Toxicity of wood smoke particulate

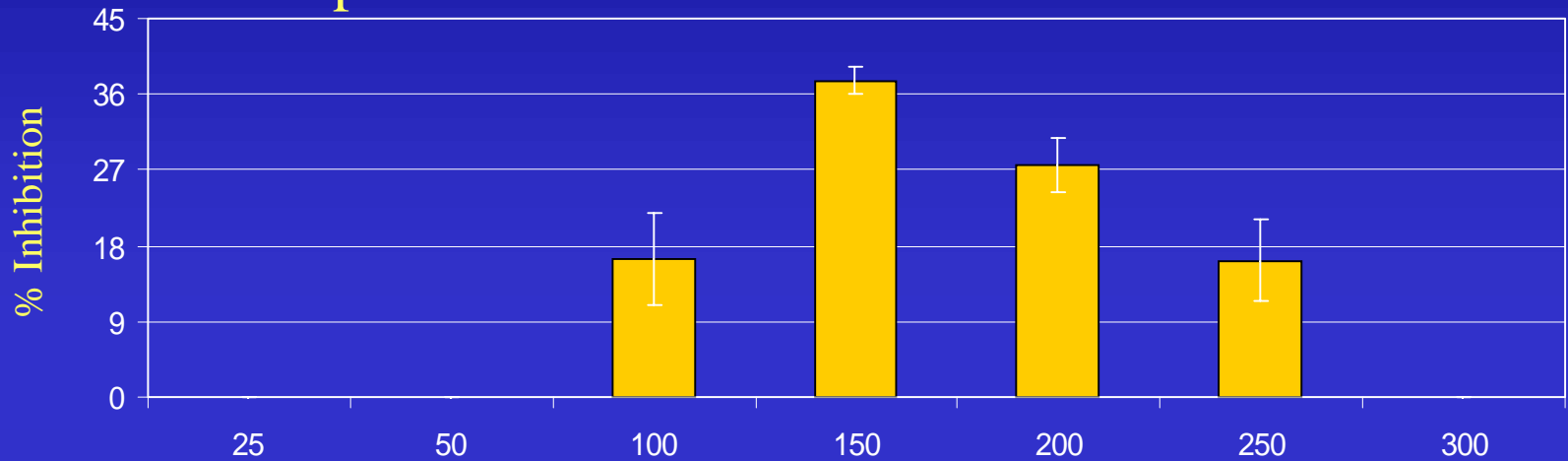


SOS Chromotest - Wood Smoke Particulate

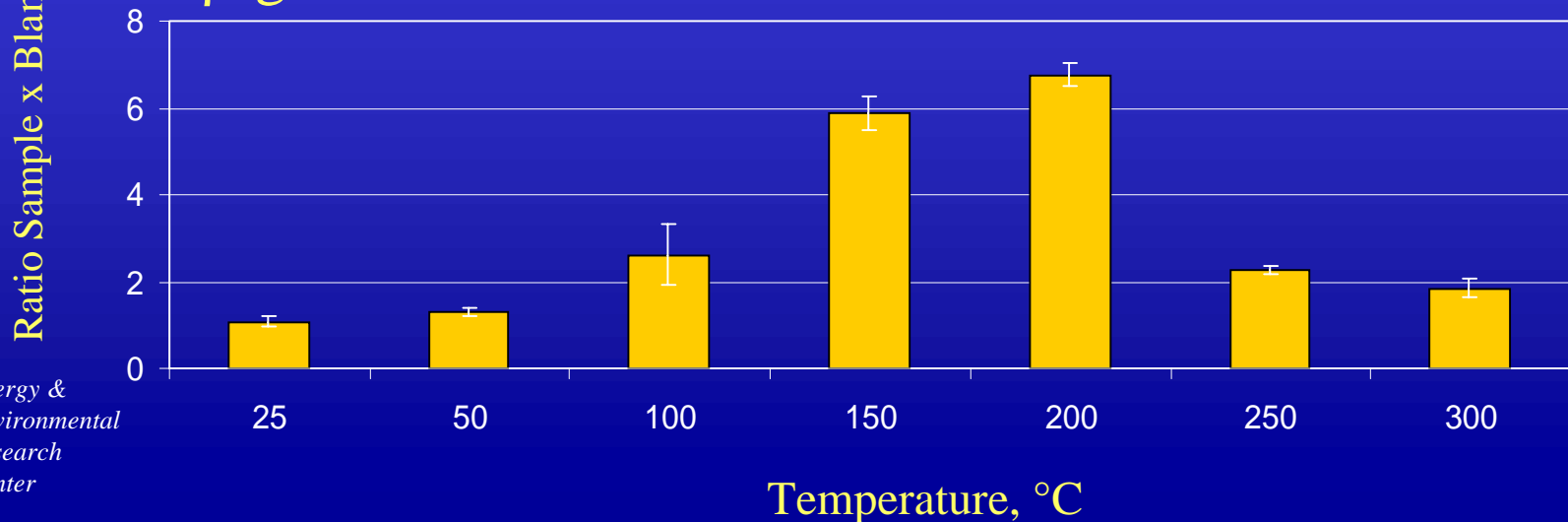


SOS Chromotest - Diesel Exhaust Particulate

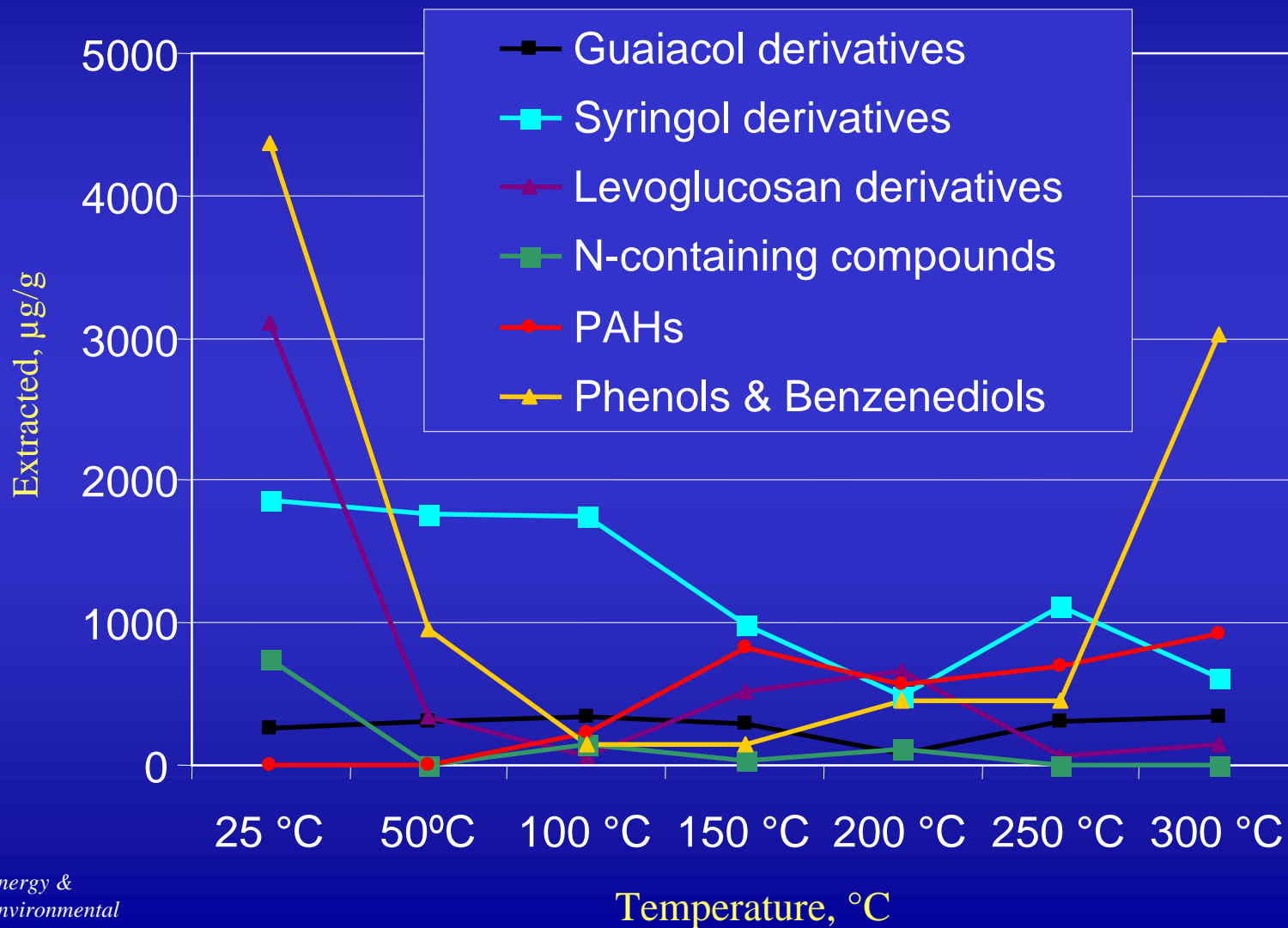
Total protein inhibition



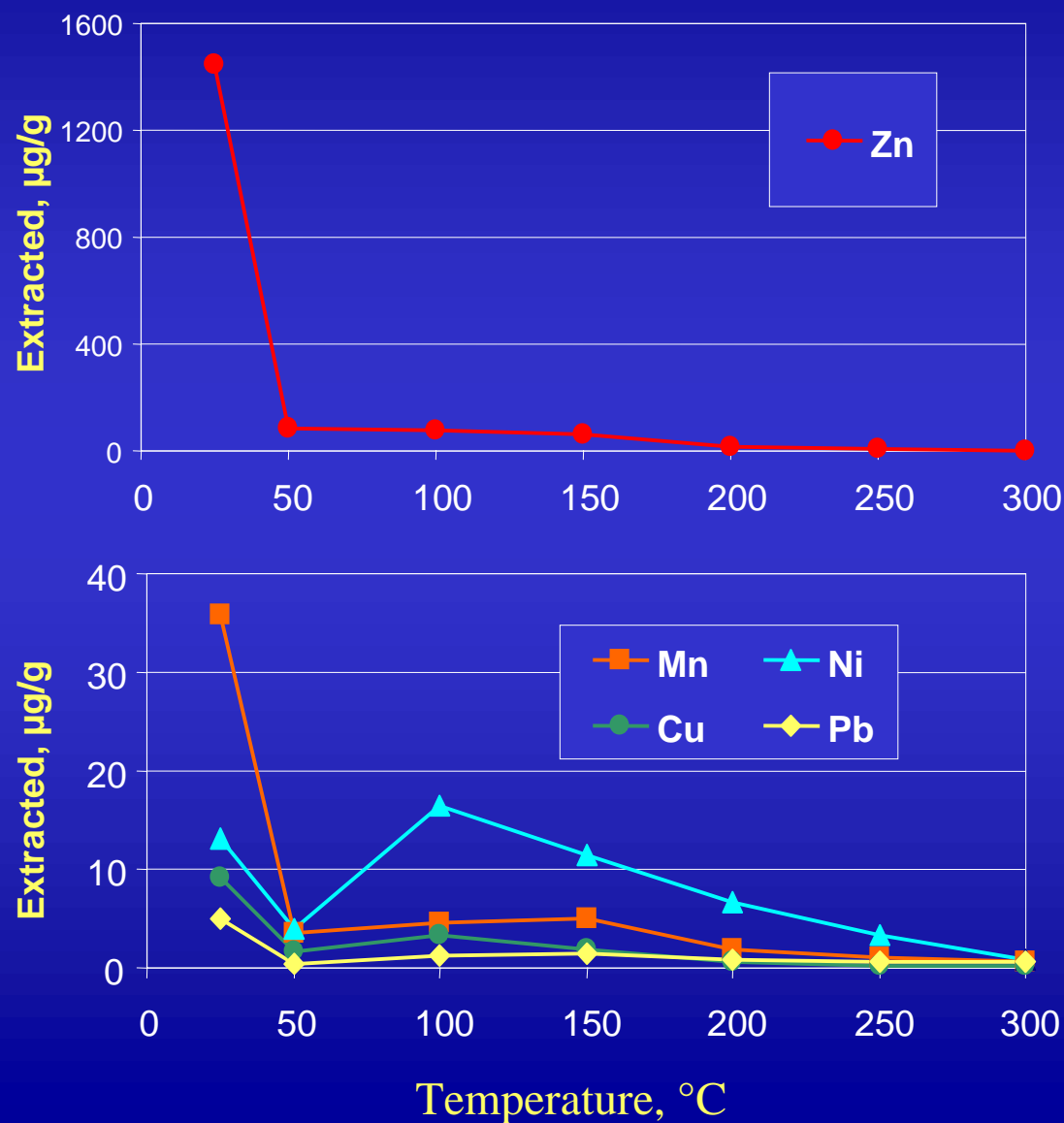
β -galactosidase formation



Distribution of Different Classes of Organics in Wood Smoke Particulate Extracts Collected at Different Temperatures



Metals Determined Using ICP/MS in Diesel Exhaust Particulate



Conclusions

- Subcritical water can selectively extract organics.
- Hot water extracts more than most of the solvents.
- Most toxicity was found in the polar fractions, fractions which are not expected to be extracted by organic solvents.
- GC/MS characterization of wood smoke particulate showed phenols, benzenediols and levoglucosan extracted preferentially in lower temperature fractions.
- Higher content of sulfur and zinc was found in the lower-temperature fraction of diesel exhaust.
- The results indicate that standard methods employing organic solvents neglect characterizing the polar fractions of aerosol particulate which are important from a toxicological point of view.
- In future work, the toxicity test of diesel exhaust will be completed. The subcritical water extraction method and toxicity tests will be applied to an ambient aerosol sample.

